PSEG

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Nuclear Business Unit

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U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Dear Sir:

HOPE CREEK GENERATING STATION
DOCKET NO. 50-354
UNIT 1
LICENSEE EVENT REPORT 95-020-01

This Supplemental Licensee Event Report entitled "Automatic Actuation of the High Pressure Coolant Injection System's Suction Path Swapover Engineered Safety Feature" is being submitted pursuant to the requirements of 10CFR50.73(a)(2)(iv).

Sincerely,

Mark E. Reddemann
General Manager -
Hope Creek Operations

SORC Mtg. 95-110
Attachment

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LER File 3.7

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NRC FORM 366 (4-95) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES 04/30/98

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS MANDATORY INFORMATION COLLECTION REQUEST: 50.0 HRS. REPORTED LESSONS LEARNED ARE INCORPORATED INTO THE LICENSING PROCESS AND FED BACK TO INDUSTRY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-6 F33), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

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TITLE (4)

Automatic Actuation of the High Pressure Coolant Injection System's Suction Path Swapover Engineered Safety Feature

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
09	08	95	95	020	01	11	30	95		05000
									FACILITY NAME	DOCKET NUMBER
										05000

OPERATING MODE (9)	1
POWER LEVEL (10)	100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)

20.2201(b)	20.2203(a)(2)(v)	50.73(a)(2)(i)(B)	50.73(a)(2)(viii)
20.2203(a)(1)	20.2203(a)(3)(i)	50.73(a)(2)(ii)	50.73(a)(2)(x)
20.2203(a)(2)(i)	20.2203(a)(3)(ii)	50.73(a)(2)(iii)	73.71
20.2203(a)(2)(ii)	20.2203(a)(4)	X 50.73(a)(2)(iv)	OTHER
20.2203(a)(2)(iii)	50.36(c)(1)	50.73(a)(2)(v)	Specify in Abstract below or in NRC Form 366A
20.2203(a)(2)(iv)	50.36(c)(2)	50.73(a)(2)(vii)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
G. Daves	(609) 339-3071

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE).	NO X				

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

On September 8, 1995, at 1515 hours, an automatic actuation of the Engineered Safety Feature (ESF) associated with the High Pressure Coolant Injection (HPCI) System's suction path occurred during full power operation. HPCI is designed to initially inject water into the Reactor Pressure Vessel from the Condensate Storage Tank (CST). When the water level in the CST falls below a predetermined level or the Suppression Chamber (Torus) water level is high, the pump suction is automatically transferred to the Torus. Initial Torus water level was 76.8 inches on Safety Parameter Display System (SPDS) prior to the event. Various activities which affect sensed Torus water level were being conducted prior to the event. All equipment responded properly to the sensed Torus high water level signal. This supplement provides the root cause, contributing factors, and associated corrective actions to prevent recurrence. The primary root cause was absence of a realistic operating band considering loop inaccuracies and routine process perturbations. The major corrective action incorporates a realistic operating band into the Operations procedure to prevent recurrence of this event.

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TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

PLANT AND SYSTEM IDENTIFICATION

General Electric - Boiling Water Reactor (BWR/4)
High Pressure Coolant Injection System: BJ, EIIS Identifier: BJ

IDENTIFICATION OF OCCURRENCE

TITLE (4): Automatic Actuation of the High Pressure Coolant Injection System's Suction Path Swapover Engineered Safety Feature

Event Occurrence: September 8, 1995
Event Time: 1515 hours EST
Discovery Date: September 8, 1995

CONDITIONS PRIOR TO OCCURRENCE

Plant in OPERATIONAL CONDITION 1 (Power Operation)
Reactor Power 100% of rated, 1079 MWe

DESCRIPTION OF OCCURRENCE

On September 8, 1995 at 1515 hours, during normal full power operations, the Hope Creek Generating Station (HCGS) experienced an automatic actuation of an Engineered Safety Feature (ESF) when the pump suction path swapover on the HPCI system portion of the Emergency Core Cooling System (ECCS) occurred due to high Torus water level. All equipment associated with the ESF actuation functioned properly and the operator response to the event was in accordance with plant procedures and the requirements of HCGS's Technical Specifications. This occurrence is reportable as a Licensee Event Report under 10CFR50.73(a)(2)(iv) as "any event or condition that resulted in a manual or automatic actuation of any Engineered Safety Feature."

A Corrective Action Program Action Request was initiated on September 8, 1995 to determine the root cause and establish corrective actions for this event. In addition, the Nuclear Regulatory Commission (NRC) was notified in accordance with 10CFR50.72(b)(2)(ii), since an unplanned automatic ESF actuation is reportable as a notification to the NRC Operations Center within four hours of identification of such an event. Operations performed this notification at 1714 hours.

DESCRIPTION OF OCCURRENCE (cont'd)

On September 8, 1995, the Residual Heat Removal (RHR) System was placed in Torus Cooling mode at 0247 hours to lower Torus water temperature. Torus water temperature was at 91 degrees F due in part to three (3) weeping Safety Relief Valves (SRVs). Torus water level was also higher than normal due in part to in leakage from the SRVs. Continual monitoring of Torus Level using: 1) the Safety Parameter Display System (SPDS) (which averages the two wide range level indications); and 2) the narrow range level indication was performed regularly during the shift.

Considering the recent July 3, 1995 HPCI Suction Swapover ESF actuation and the Torus water level conditions described above, operators discussed the potential need to lower Torus water level using the "A" loop of Residual Heat Removal (RHR) as it was already in service in Torus Cooling Mode. The "RHR System Operation" procedure, HC.OP-SO.BC-0001, was referenced to determine whether an approved method existed for reducing Torus level using the "A" RHR loop. It was determined that procedural guidance did not exist to reduce level using the "A" RHR loop. Methods to change the "RHR System Operation" procedure to allow use of the "A" loop via the On The Spot Change (OTSC) process were discussed but dismissed by the operators. The reasons for dismissal were: 1) there is no automatic signal from the Primary Containment Isolation System for the "A" loop of RHR, 2) the piping rating for the "A" loop of RHR is 150 psi whereas the "B" loop of RHR is rated for 500 psi, and 3) a procedure existed to use "B" RHR to letdown.

The possibility of using the "B" RHR loop to reduce Torus level was also discussed. However, the operators believed that, in order to use the "B" loop of RHR to reduce Torus level, an excessive number of component manipulations of safety systems were required. As a result, they discounted using the "B" RHR loop. The operators were not aware of steps in the procedure which allowed using the "B" loop of RHR to reduce level without these component manipulations.

Another method used at HCGS for controlling Torus water level is to use the Torus Water Clean-up Pump to pass Torus Water through the Fuel Pool Cooling and Clean-up System Filter Demineralizer and into the CST in accordance with procedure HC.OP-SO.EE-0001, entitled "Torus Water Cleanup System Operation." Operators understood that the system was impaired but called Radwaste to see if it could be used to reduce Torus water level. They were informed by Radwaste that the system remained unavailable for Torus level reduction, as was the case during the July 3, 1995 ESF actuation.

DESCRIPTION OF OCCURRENCE (cont'd)

The need to reduce Torus water level was not seen as urgent. Relying on SPDS as primary indication, the operators believed that sufficient margin existed before reaching the trip setpoint. Consequently, they allowed Torus level reduction to be deferred to some point on the next shift when there were less activities scheduled.

Drywell Nitrogen Makeup was initiated at 1415. Drywell Nitrogen Makeup is required more frequently due to a temporary modification to the Primary Containment Instrument Gas Compressor (PCIG). This modification increases Nitrogen leakage from the Drywell due to bypassing of the PCIG moisture removal traps. Nitrogen Makeup to the Drywell does cause a slight increase in Torus water level, until Nitrogen Makeup to the Torus equalizes the pressure between the Drywell and the Torus.

Prior to the event, the SPDS indicated an average level of 76.8 inches. However, Torus level was being maintained within the Normal Torus Level Range of 75 inches to 78 inches, as specified in the Operations Daily Surveillance Log.

At 1515 EST, the B1-C3 overhead alarm was received indicating Torus water level was high (i.e., had exceeded the trip setpoint) and the resultant ESF actuation occurred when the HPCI pump suction valve swapped from the CST to the Torus. The level recorder from the narrow range is the control room instrument used to satisfy the shiftly surveillance requirement for Torus water level. The Torus water level narrow range indication was 77.8 inches, while SPDS indicated 77.0 inches. The trip units were not found in the tripped condition after the event, indicating that the high Torus water level was only momentary.

ANALYSIS OF OCCURRENCE

Per HCGS, Technical Specification (TS) 3.6.2.1, the allowed level, as indicated, for the Suppression Chamber is between 74.5 inches and 78.5 inches. Per TS Table 3.3.3-2, the HPCI Torus Level Trip Setpoint for the pump suction path ESF swapover is </= 78.5 inches with an Allowable Value of </= 80.3 inches.

The current guidance for maintaining torus level is found in the Operations Daily Surveillance Log (DL-026), which specifies a normal torus level range of 75 to 78 inches. A review of previous revisions to DL-026 revealed that this band has existed for many years and that no documented basis for the band could be found. The narrow range level indicator LI-R602A is logged in DL-026 to ensure torus level is maintained within the T.S. limit.

ANALYSIS OF OCCURRENCE (cont'd)

In reviewing the loop setpoint calculation, the projected loop accuracy of each of the two narrow ranges from the transmitter to the trip unit is 2.4% of span or 0.48 inches. The indication portion of this same loop is listed as 2.4% of span or 0.48 inches. The DL-026 operating band upper limit margin of 0.5 inches, (78 inches versus the trip point of 78.5 inches), does not reflect potential inaccuracies. This margin also does not consider level perturbations such as pump operation or drywell makeup. Had a more reasonable operating band been established, the suction swap would not have occurred.

Conclusions: The level band established for torus Level does not provide any "buffer" for level fluctuations or for an instrument being slightly out of tolerance.

Calibration checks were conducted on the instruments in both the wide range and the narrow range indication and actuation loops. The wide range instrumentation (i.e., transmitters, trip units, and indicators) was found to be within its calibration tolerances.

The logic for the narrow range instrumentation is designed such that there are two channels (A and E), either of which can cause the HPCI suction swap on high Torus level. However, only the "A" channel provides indication to the control room. Channel "A" was found to be calibrated approximately 0.1 inches high but still within its calibration tolerance, while channel "E" was found out of calibration about 0.25 inches high.

A review of calibration records over the last five years for the narrow range "A" and "E" transmitter was conducted to identify any trend in the transmitters being out of calibration. The "A" transmitter was found out of calibration one time within the past 5 years. The "E" transmitter had not been found out of calibration any other time within the past 5 years.

Conclusions: The "E" channel out of calibration contributed to the HPCI suction swap occurring at a lower level than the 78.5 inches setpoint.

ANALYSIS OF OCCURRENCE (cont'd)

The logic for the narrow range instrumentation is designed such that there are two channels (A and E), either of which can cause the HPCI suction swap on high torus level. Only the "A" channel provides indication to the control room. The "E" channel can only be monitored as an analog computer point on CRIDS. Either narrow range channel inputs into the overhead alarm, (OHA), and the swap logic. Per current design, there is no preaction alarm. The same trip unit which inputs into the OHA inputs into the swap logic simultaneously, therefore no warning is provided prior to the suction swap.

A preaction alarm is particularly critical in this application since the T.S. band, the instrument accuracy's and the normal operating range allow little operational flexibility. The additional barrier of a high level alarm which annunciates approximately 0.5" prior to the actuation setpoint has potential to prevent reoccurrence.

Conclusion: The lack of a pretrip alarm could have contributed to the event.

As mentioned previously, the Torus water level and Torus water temperature were higher than typical due in part to leakage into the Torus as a result of 3 weeping SRVs. Because of high Torus water temperature, Torus Cooling was placed in service. One method for controlling Torus water level, using the Torus Water Clean-up Pump to pass Torus Water through the Fuel Pool Cooling and Clean-up System Filter Demineralizer and into the CST, was unavailable, as was the case during the July 3, 1995 ESF actuation. In addition, Drywell Nitrogen Makeup is required more frequently due to leakage of Nitrogen out of the Drywell through the open bypass valves around the moisture removal traps on the Primary Containment Instrument Gas Compressor.

Conclusion: Hardware problems contributed to the need to reduce torus level with the RHR system more frequently than normal. While not considered a root cause, the cumulative effect of these problems contributed to this event.

The possibility of using the B" RHR loop to reduce torus level was also discussed. However, the operators believed that, in order to use the B" loop of RHR to reduce torus level, an excessive number of component manipulations were required. As a result, they discounted using the B" RHR loop.

ANALYSIS OF OCCURRENCE (cont'd)

The operators were not aware of steps in procedure HC.OP-SO.BC-0001, "RHR System Operation," which allowed using the B" loop of RHR to reduce level without lengthy component manipulations. Had the operator reviewed HC.OP-SO.BC-0001, a separate subsection for torus level reduction with the "B" loop would have been noted. Utilizing the "B" RHR loop to reduce level could have averted the event.

The other procedure related to the event was HC.OP-SO.GS-0001, Drywell Nitrogen Makeup. Drywell N2 makeup was initiated 1 hour prior to the event. This procedure provides a precaution describing drywell makeup and the impact the displaced water will have on torus level. This procedural enhancement was added as a result of the July 3, 1995 ESF actuation. This precaution was inadequate in that it did not provide specific guidance on the magnitude of the impact on torus level nor a caution to lower level prior to the makeup. However, regardless of the adequacy of the procedure change, the issue related to the September 8th event is that the operators were not aware that any change at all had been made to the procedure regarding this issue.

Conclusions: The operators were unaware of the ability to reduce torus water using "B" RHR without lengthy component manipulations.

The practice of not reviewing category 3 procedures resulted in a missed opportunity to preclude the event.

The LER on the July 3, 1995 ESF actuation of this system was reviewed in Licensed Operator Requalification Training. However, the shift operating crew did not expect an imminent trip of the high level instrumentation based on the indicated level.

ANALYSIS OF OCCURRENCE (cont'd)

The SPDS indication, which is easily read and is perceived to be more accurate because it is a digital output to one decimal point (i.e. one tenth inch), is the average of the wide range indicators. The wide range indicators, and ultimately SPDS, have a larger inaccuracy than the narrow range indication, even though the narrow range is displayed on a strip recorder and the smallest specified increment is one inch. The slight pressure increase, and the resultant level increase, from the Drywell Nitrogen Makeup was not readily apparent on the wide range instrumentation. The narrow range level indicator and recorder (LI/LR-4805) are the normal method to observe torus water level, as taught in Initial License Operator Training.

The operators were not aware that SPDS exclusively received input from the wide range transmitters and that as a result the SPDS indication could be more inaccurate than the narrow range indication. The operators also did not know that the narrow range transmitters are the transmitters that feed the trip unit which generates the ESF actuation. Therefore, the operators were using the less accurate SPDS indications to influence their decision to not reduce Torus water level.

The Simulator fidelity does not include "total loop" accuracy allowances. When operators are trained in the Simulator, the ESF actuation that causes HPCI suction swapover on high Torus water level occurs when both SPDS and the narrow range indicator are indicating 78.5 inches of water in the Torus. The simulator also does not model the affect that Drywell Nitrogen Makeup has on Torus water level. These simulator modeling limitations have contributed to operator reliance on less accurate instrumentation.

Conclusions: The perceived accuracy of the SPDS indication created a false reliance on indication driven from wide range transmitters.

Operators were weak in the basic knowledge of instruments causing the HPCI suction swap actuation.

ANALYSIS OF REPEAT OCCURRENCE

The root cause of the July event stated that shift personnel did not fully understand the potential effects of "total loop" accuracy. Knowing loop accuracy would not have prevented either event.

Review of the root cause analysis of the July event indicated that data collection and potential failure mode identification were weak. Specifically,

- Alarm chronolog data from the plant computer was not obtained

- Instrument calibration was not checked after the July event, even though the trip occurred below the setpoint.

The corrective actions associated with the July 3, 1995 event were narrowly focused, ineffective, and untimely. The fundamental reason that the corrective actions from the July 3rd event were ineffective was that the root cause of the event was not identified.

A number of actions were initiated following the July event. These include:

1) the LER from the previous actuation was reviewed in Licensed Operator Requalification Training,
2) a note was added to HC.OP-SO.GS-0001 regarding the drywell makeup impact and,
3) a night order book entry was made on 8/3/95 to "sensitize" operators to the impact of instrument accuracies have on setpoints.

However, the corrective actions that were implemented -- sensitization of the operators, precaution added to procedure were -- ineffective, in that they did not discuss specific lessons learned, nor did they provide clear direction to monitor the narrow range instrumentation.

Implementation of some of the actions specified in the July event were untimely. Personnel assigned the root cause for the 7/3/95 event were not familiar with the recently revised administrative procedure governing the Corrective Action Program (CAP). As a result, the corrective actions associated with the July 3, 1995 event were not entered into the CAP until September 20, 1995. One of the identified corrective actions as a result of the July 3rd ESF actuation was to issue a letter to Operations personnel covering lessons learned. This corrective action was not completed prior to the September 8th ESF actuation. It has since been completed.

ANALYSIS OF REPEAT OCCURRENCE (cont'd)

A corrective action taken as a result of the July 3, 1995 ESF actuation was a change to the drywell nitrogen make-up procedure. It has been determined that the corrective action would not have been effective in precluding repeat events. The change did not provided a clear precaution with regard to nitrogen makeup to the drywell causing small increases in torus level. Specifically, it did not include a predetermined upper torus water level that would not cause an ESF actuation, nor did it identify the proper instrumentation to determine level (i.e. the instrument generating the trip).

No effort was specified or made to ensure that the corrective actions as implemented were effective.

APPARENT CAUSE OF OCCURRENCE

The primary cause of this event was the absence of a realistic operating band considering loop accuracies and routine process perturbations. Major contributing factors were: 1) inappropriate use of level indication instrumentation, 2) inappropriate procedure usage, and 3) failure to identify the root cause from a previous event and implement effective corrective actions. Other contributing factors were: 1) a transmitter that was out of calibration, and 2) degraded equipment.

SAFETY SIGNIFICANCE

There is no negative safety impact introduced by the automatic transfer of the HPCI suction path.

The HPCI Torus Suction Valve automatically opens upon receipt of a low CST level or high Torus level. The automatic suction transfer has no impact on the initiation or operation (other than to shift to a more reliable suction source) of the HPCI system, nor on the conditions under which the system will isolate. The opening interlock itself provides increased system reliability. Therefore, there is no impact on the ability of HPCI to perform its intended function.

PREVIOUS OCCURRENCES

There was one previous occurrence of an unplanned HPCI suction swapover reported in LER 95-014 dated August 2, 1995.

CORRECTIVE ACTIONS

1. The roles and responsibilities of the personnel assigned implementation of the CAP have been emphasized to the organization. Station Management has emphasized specific expectations to Station personnel regarding the rigor of this process in preventing repeat events.

2. As an interim action, a night order was issued on 9/11/95 to administratively limit Torus water level to 77 inches as indicated on the narrow range indicator.

3. Calibration checks were completed for all Torus water level transmitters. The one narrow range transmitter found out of calibration was recalibrated.

4. Expectations regarding the use of category 3 procedures were clarified.

5. Appropriate corrective maintenance will be completed on the Torus Water Clean-up System. (Prior to startup)

6. Appropriate corrective maintenance will be performed on the weeping SRVs. (Prior to startup)

7. Potential design changes are being evaluated to minimize Nitrogen leakage from the Drywell due to the Primary Containment Instrument Gas system and ill be implemented during a PCIG system outage in 1996.

8. A realistic operating band was incorporated into the Operations procedure.

9. Operator training will be evaluated for appropriate changes in the following areas: 1) which instrumentation feeds SPDS and the resultant effects; 2) Qualification, Verification, and Validation with respect to redundant instrumentation and appropriate use of the most conservative indication; and 3) which instruments feed the trip unit which generates the ESF actuation. Operators will be trained using the revised lesson plans. (6/1/96)

10. A design change will be evaluated to provide narrow range inputs into the SPDS torus level algorithm. (Prior to startup)

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CORRECTIVE ACTIONS (cont'd)

11. A design change will be evaluated to provide a high level alarm prior to the actuation. (Prior to startup)

12. The final root cause analysis will be rolled down to the Operations Department. (12/15/95)

13. The precaution added to the Drywell Nitrogen Makeup procedure as a corrective action from the July 3rd event will be clarified. (4/15/95)